



NUECES BBASC STUDY #3

NUECES WATERSHED PRE- AND POST-DEVELOPMENT NUTRIENT BUDGETS

**NUECES ESTUARY ADVISORY COUNCIL
FEBRUARY 23, 2015
PAULA JO LEMONDS, PE, PG**

DISCUSSION

Background

Status

Results

Schedule

BACKGROUND

- Nueces BBASC work plan
 - Tier 2b Recommendation
- Nueces BBEST
 - BBEST Recommendations Report
 - Sec. 5.2 Nutrient Considerations
- Nueces BBASC
 - BBASC Recommendations Report
 - Sec. 4.3.2 Nutrient Considerations

GOALS

- Develop nutrient budgets based on quantitative understanding of natural supply of all nutrient forms and anthropogenic changes in these supplies over time for Nueces Bay watershed
- Determine annual loads for both the pre-development and present condition

Source: Nueces BBASC work plan



SCOPE OF WORK

- Task 1 – Compile Data
 - Compile Water Quality and Hydrologic Data
 - Long-term (1934 – 2014)
 - Short-term (1986 – 2014)
 - Recent (2004 – 2014)
- Task 2 – Perform Data Evaluation and Modeling Analyses
 - Perform Data Evaluation
 - Available data, sampling stations, and subwatersheds
 - Identify appropriate stations

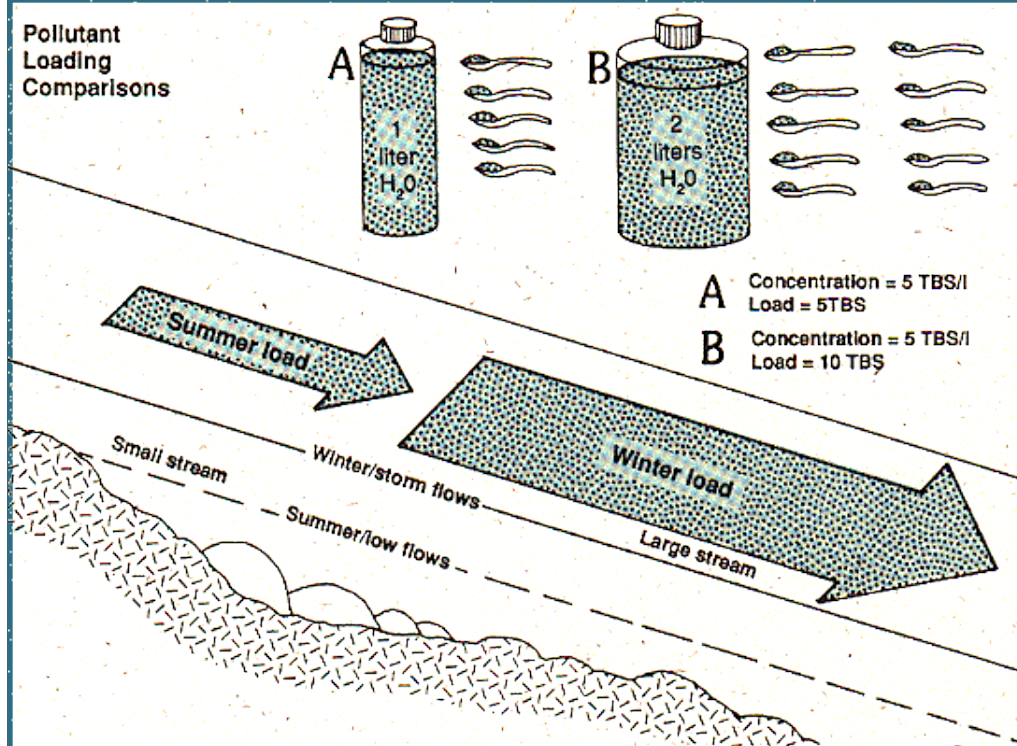


DATA ANALYSIS



CONCENTRATION VS. LOAD

- **Concentration** - Mass, weight, or volume of constituent (e.g. phosphorus, sediment, etc.) relative to volume of transporting fluid, or fluid-constituent mixture
 - Typical units - mg/L, µg/L, ppm
- **Flow or Discharge** - Rate of mass, weight, or volume transport of constituent
 - Typical units - tons/day, lbs/day, kg/s, ft³/s
- **Load** - The cumulative mass, weight, or volume of constituent delivered to some location
 - Typical units - tons, kilograms, pounds



Graphic source: Washington State Department of Ecology

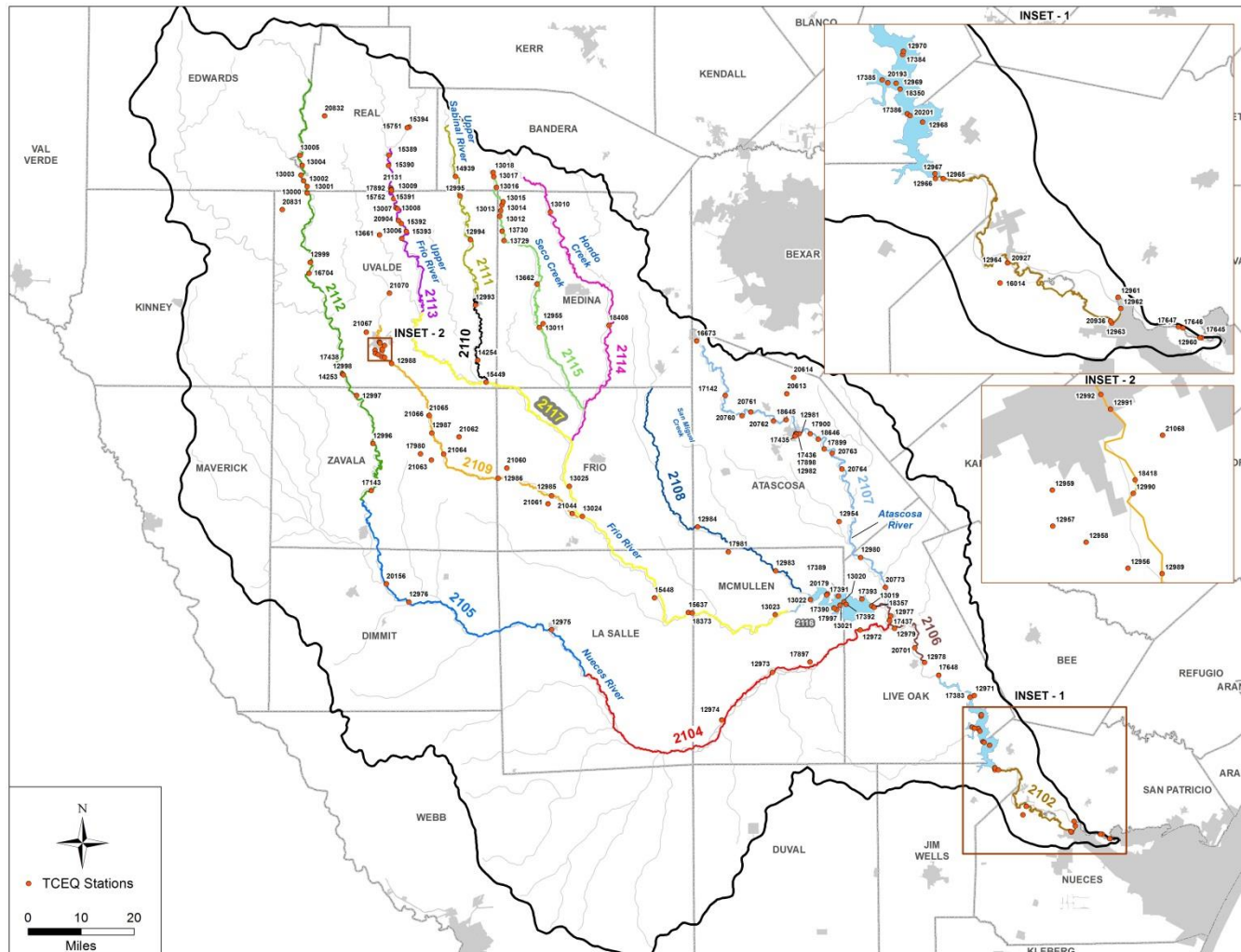
$$\text{Load (mass / time)} = \text{Conc. (mass / volume)} * \text{Flow (volume / time)}$$

REGRESSION ANALYSIS

- USGS LOADEST
- HDR linear regression



**LOAD ESTIMATOR (LOADEST):
A FORTRAN PROGRAM FOR ESTIMATING
CONSTITUENT LOADS IN STREAMS AND RIVERS**



DATA EVALUATION

- Finding Flow-Constituent pairs

Constituent (ID)	Constituent (ID)	Constituent (ID)
Constituent (text)	Constituent (text)	Constituent (text)
Station	Flow	Station
12961	10	12960
12962	13	12961
17646	4	12962
17647	3	12963
12964	57	12964
12965	109	12965
20936	1	20936
12971	1	12966
17648	3	12967
12972	25	12968
12973	161	12969
12974	7	12970
17897	8	12971
12975	85	17384
12976	56	17648
12978	14	18350
12979	244	12972
17437	9	12973
18357	5	12974
12954	1	17897
12980	106	12975
12981	23	12976
12982	81	20156
17142	0	12977
17436	11	12978
17898	13	12979
17899	8	17437
17900	20	20701
18645	10	12954
18646	11	12980
20760	0	12981
20761	1	12982
20762	15	17142
20764	10	17898
20773	14	17899
12983	106	17900
12984	1	20613
12956	21	20614
12985	64	20760
12986	1	20761
12987	43	20762
12988	56	20764
12989	19	20773
18418	21	12983
21044	2	12984
21064	1	12956
21066	0	12957
12993	117	12958
12994	164	12985
14939	8	12986
12999	156	12987

Constituent (ID)	Constituent (ID)	Constituent (ID)
Constituent (text)	Constituent (text)	Constituent (text)
Station	Flow	Station
13005	47	12988
16704	44	12989
13006	225	12990
13007	30	12992
17892	13	18418
13010	140	12993
18408	12	12994
12955	1	12995
12958	1	12995
13013	162	14939
13017	1	12999
13018	1	13000
13662	6	13001
13021	46	13002
13022	0	13003
13023	146	13004
13024	109	13005
13025	35	16704
13661	43	20831
15449	36	20832
15637	2	13006
18373	6	13007
17435	0	13008
21062	0	15751
21063	10	15752
21068	0	17892
21070	0	13010
12996	46	18408
12997	17	12955
12998	18	13011
14253	7	13012
17143	0	13013
17438	0	13014
Total	43	13015
		13016
		13017
		13018
		13017
		2
		13018
		2
		13019
		36
		13020
		85
		13021
		53
		13022
		46
		13023
		110
		15448
		84
		15449
		6
		13025
		39
		15637
		8
		13661
		33
		18373
		38
		15448
		6
		12996
		76
		15449
		46
		15637
		8
		12998
		38
		18373
		11
		12996
		76
		17143
		44
		12997
		29
		17438
		1
		12998
		10
		14253
		11
		17143
		43
		17438
		47

STATIONS EVALUATED

- Had over 12
flow-constituent
pairs

Stationid	River	Description
12962	NUECES	NUECES RIVER AT CORPUS CHRISTI CUNNINGHAM WATER TREATMENT PLANT INTAKE
12964	NUECES	NUECES RIVER AT BLUNTZER BRIDGE ON FM 666
12965	NUECES	NUECES RIVER AT LA FRUTA BRIDGE ON SH 359
12972	NUECES	NUECES RIVER AT FM 1042 BRIDGE 1.2 MILES NORTH OF SIMMONS
12973	NUECES	NUECES RIVER AT SH 16 SOUTH OF TILDEN
12975	NUECES	NUECES RIVER AT INTERSTATE BUSINESS 35C SOUTH OF COTULLA
12976	NUECES	NUECES RIVER BRIDGE ON FM 190 NORTH OF ASHERTON
12978	NUECES	NUECES RIVER AT US 59 EAST OF GEORGE WEST
12979	NUECES	NUECES RIVER BRIDGE ON US 281 SOUTH OF THREE RIVERS
12980	ATASCOSA	ATASCOSA RIVER AT FM 99 BRIDGE WEST OF WHITSETT
12981	ATASCOSA	ATASCOSA RIVER ON DIRT ROAD DIRECTLY EAST OF PLEASANTON AT RAILROAD BRIDGE
12982	ATASCOSA	ATASCOSA RIVER AT US 281 AT PLEASANTON
12983	SAN MIGUEL	SAN MIGUEL CREEK AT SH 16 NORTH OF TILDEN
12985	LEONA RIVER	LEONA RIVER AT FM 1581 SOUTHWEST OF PEARSALL
12987	LEONA RIVER	LEONA RIVER AT US 57 NEAR BATESVILLE
12993	SABINAL RIVER	SABINAL RIVER BRIDGE AT US 90 WEST OF SABINAL
12994	SABINAL RIVER	SABINAL RIVER 12.5 MILES NORTH OF SABINAL AND 2.3 MILES DOWNSTREAM FROM THE MOUTH OF UNION CREEK 4.13 KM NW OF INTERSECTION OF RM 187/FM 1796
12996	NUECES	NUECES RIVER 20 M UPSTREAM OF US 57 SOUTH OF UVALDE
12997	NUECES	NUECES RIVER WEST BANK 60 M DOWNSTREAM OF US 83 BRIDGE SOUTH OF UVALDE
12999	NUECES	NUECES RIVER 1 MILE NORTHEAST OF LAGUNA AND 0.54 MILES DOWNSTREAM FROM SYCAMORE CREEK 2.5 MILES UPSTREAM OF ST HWY 55 BRIDGE

STATIONS EVALUATED

Stationid	River	Description
13005	NUECES	NUECES RIVER AT SH 55 SOUTH OF BARKSDALE
13006	FRIO	FRIO RIVER AT SH 127 EAST OF CONCAN
13007	FRIO	FRIO RIVER AT MAGERS CROSSING/OLD LEAKEY RD 670 M DOWNSTREAM OF GARNER STATE PARK DAM
13010	HONDO	HONDO CREEK 150 M DOWNSTREAM OF RR 462 BRIDGE NEAR TARPLEY
13013	SECO CREEK	SECO CREEK AT MEDINA CR 111 ON MILLER RANCH NEAR UTOPIA AT 4TH CROSSING DOWNSTREAM OF SH 470
13021	CHOKE CANYON	CHOKE CANYON RESERVOIR AT CHOKE CANYON STATE PARK 70 M NORTH OF WESTERN CORNER OF PENNSULA WEST OF CAMPGROUND
13023	FRIO	FRIO RIVER AT SH 16 IN TILDEN
13024	FRIO	FRIO RIVER AT IH 35 NORTHBOUND BRIDGE NORTH OF DILLEY
13025	FRIO	FRIO RIVER AT FM 1581 SOUTHWEST OF PEARSALL
14253	NUECES	NUECES RIVER AT FM 481 SW OF UVALDE
17892	FRIO	FRIO RIVER AT APACHE BLUFFS 450 M UPSTREAM OF FM 1120
17898	ATASCOSA	ATASCOSA RIVER 150 METERS DOWNSTREAM OF HUNT ROAD
17899	ATASCOSA	ATASCOSA RIVER 500 METERS SOUTHWEST OF INTERSECTION OF LEAL RD AND MOPAC RAILROAD
17900	ATASCOSA	ATASCOSA RIVER AT IH 37
20762	ATASCOSA	ATASCOSA RIVER AT GRANATO ROAD / TAYLOR ROAD 1.5 KILOMETERS UPSTREAM OF THE CONFLUENCE WITH SALT BRANCH CREEK IN ATASCOSA COUNTY
20764	ATASCOSA	ATASCOSA RIVER AT FM 541 4.75 KILOMETERS UPSTREAM OF THE CONFLUENCE WITH LIVE OAK CREEK IN ATASCOSA COUNTY
20773	ATASCOSA	ATASCOSA RIVER 650 METERS EAST AND 214 METERS NORTH FROM WHERE THE NORTH END OF LIVE OAK CR 413 DEAD ENDS 1.81 KILOMETERS DOWNSTREAM OF THE CONFLUENCE WITH BRUS

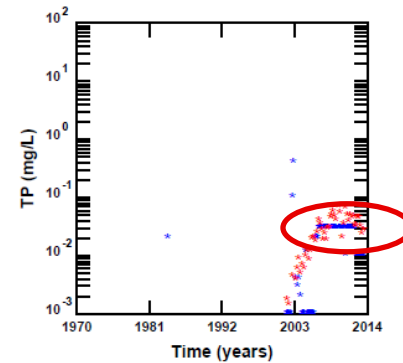
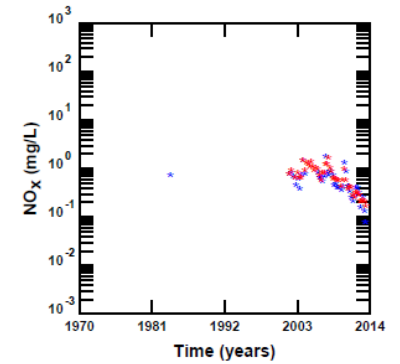
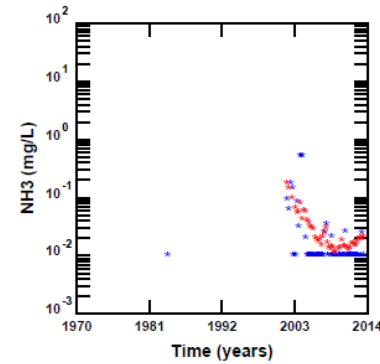
LOADEST RESULTS

- Snapshot of results upstream to downstream along Nueces River:
- 13005 Nueces at SH 55 south of Barksdale
- 12973 Nueces at SH 16 south of Tilden
- 12979 Nueces on US 281 south of Three Rivers
- 12964 Nueces at Bluntzer Bridge on FM 666



LOADEST RESULTS

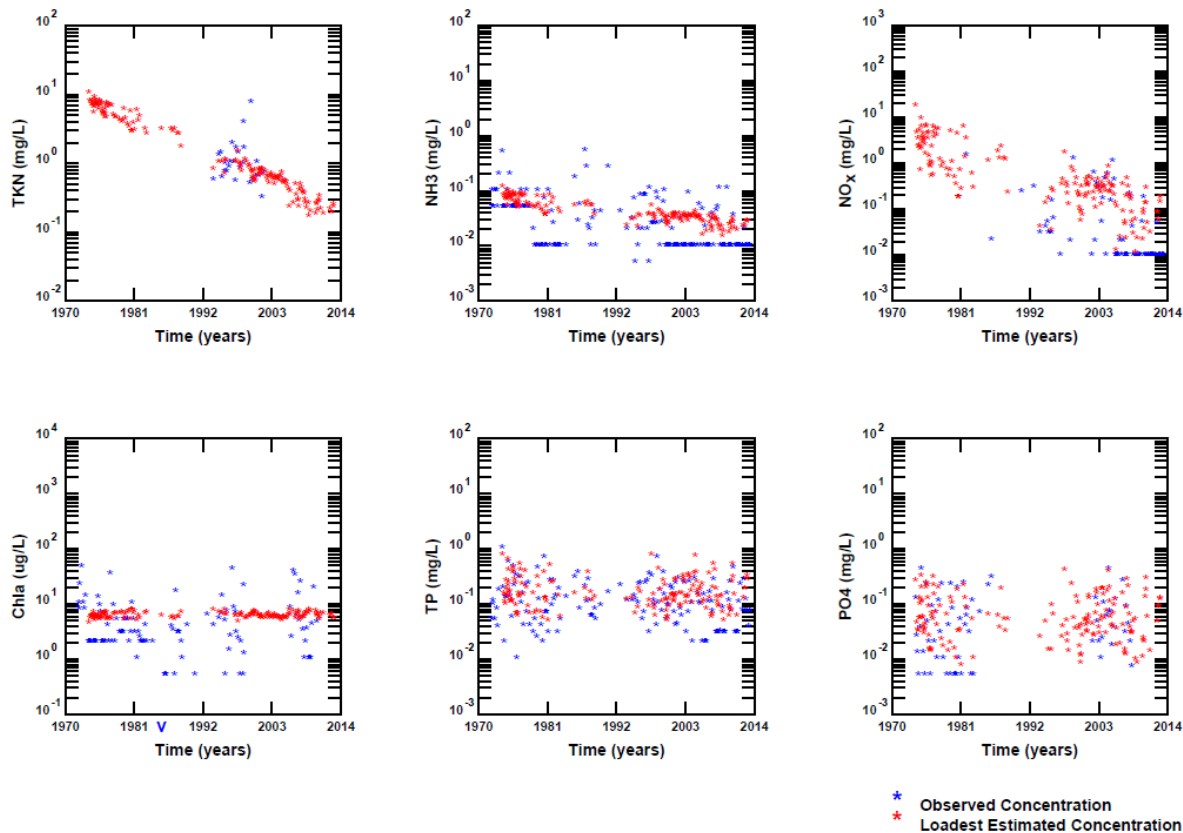
Concentration



* Observed Concentration
* Loadest Estimated Concentration

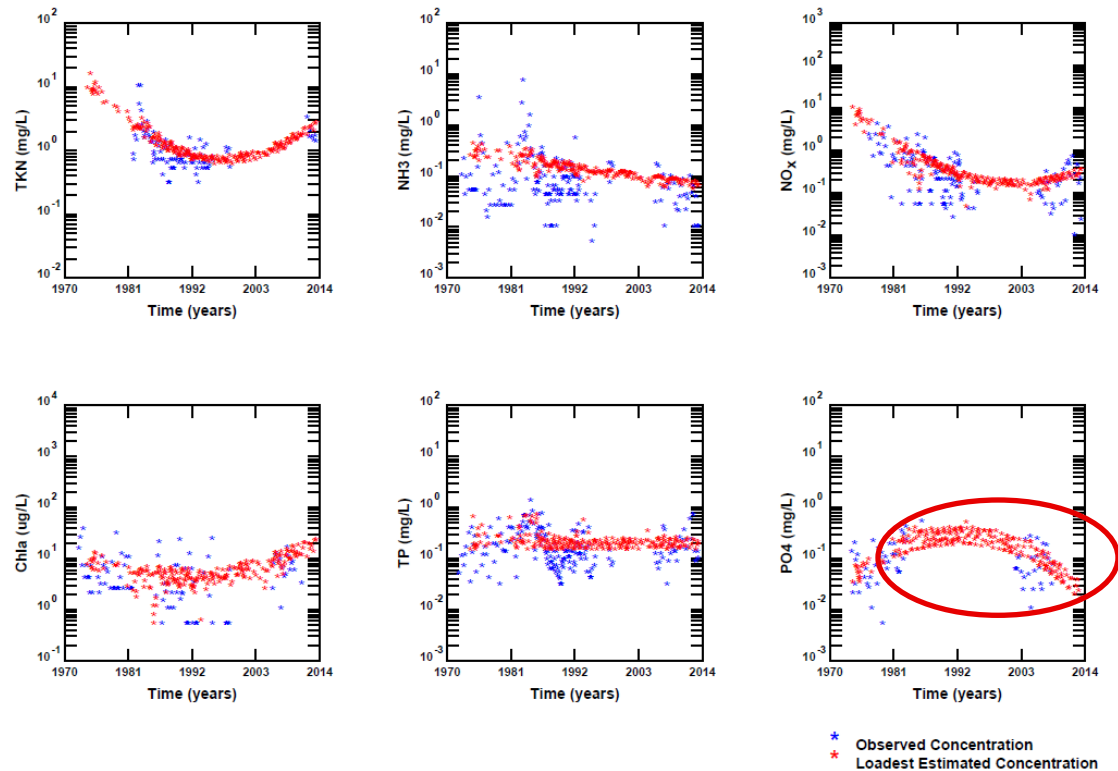
Observed Data vs. Loadest Estimated Concentration, Station 13005

Nueces Tributaries, Texas (1970-2014)



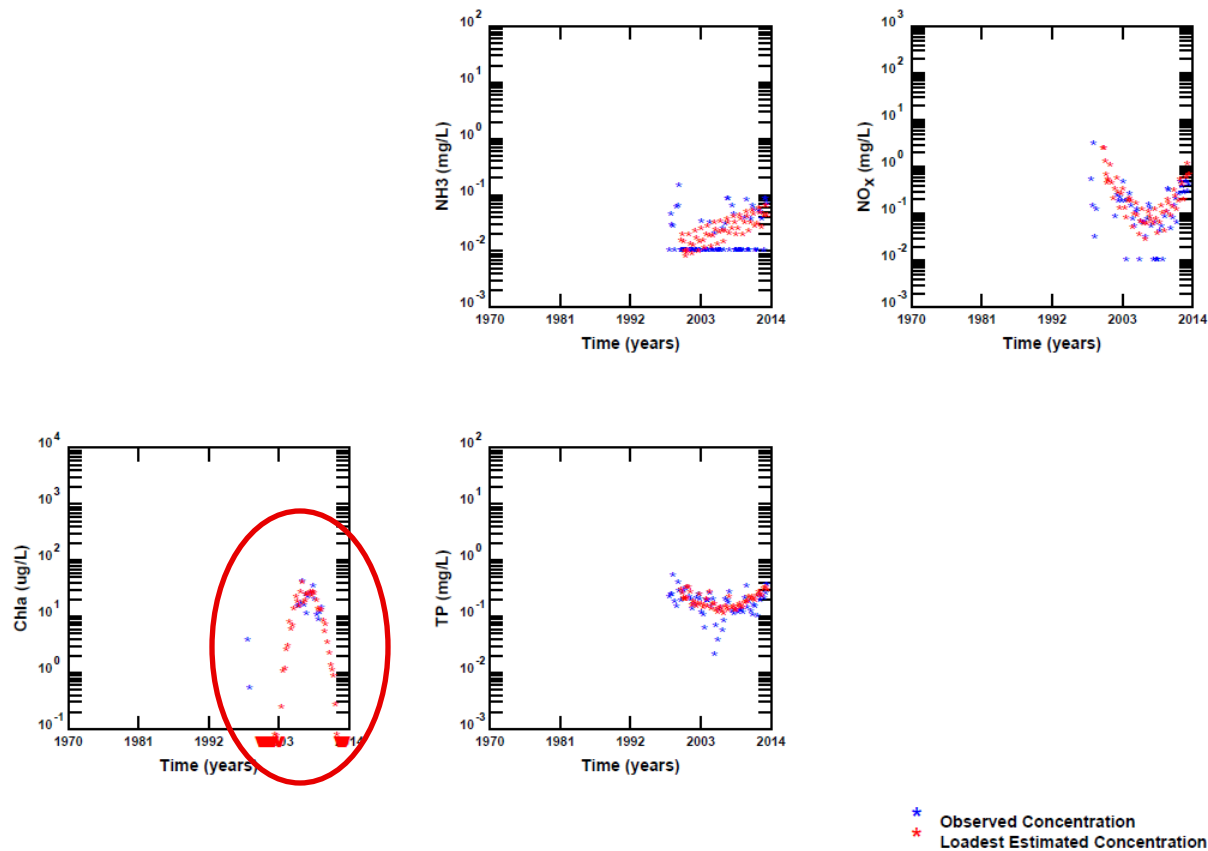
Observed Data vs. Loadest Estimated Concentration, Station 12973

Nueces Tributaries, Texas (1970-2014)



Observed Data vs. Loadest Estimated Concentration, Station 12979

Nueces Tributaries, Texas (1970-2014)

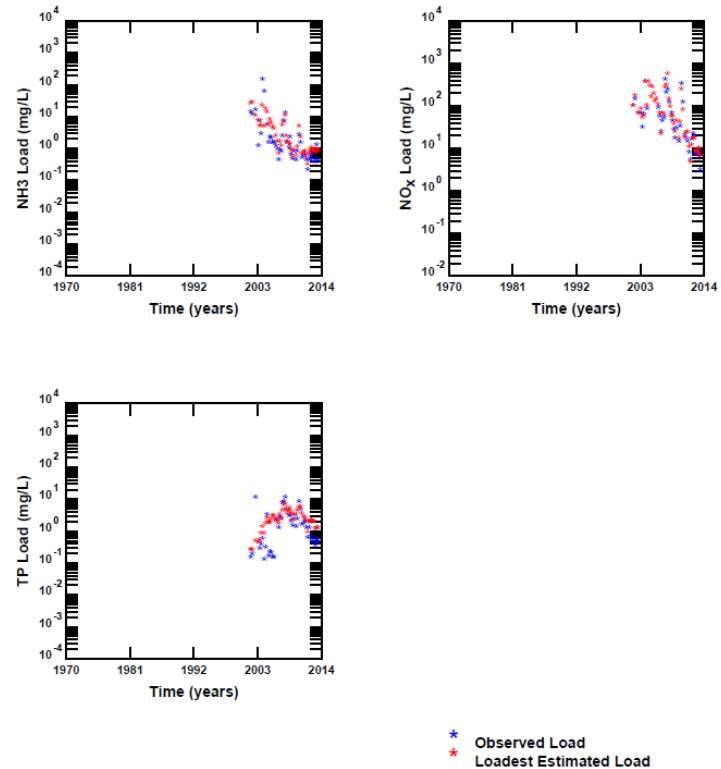


Observed Data vs. Loadest Estimated Concentration, Station 12964

Nueces Tributaries, Texas (1970-2014)

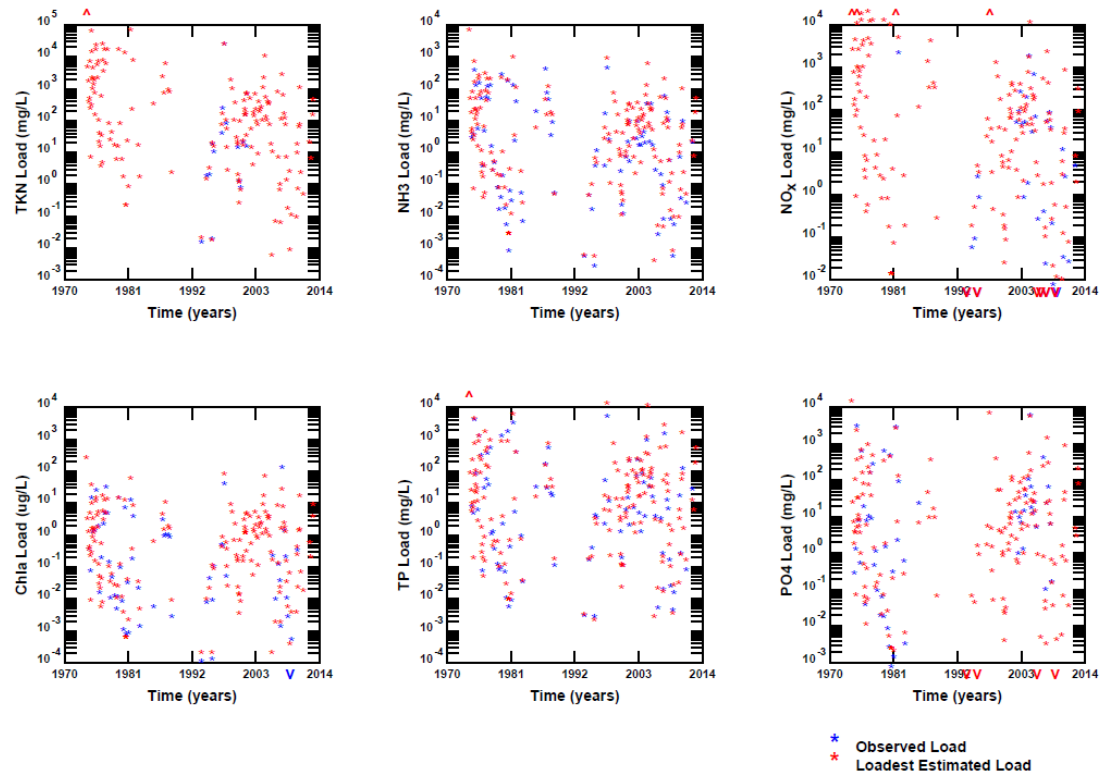
LOADEST RESULTS

Load



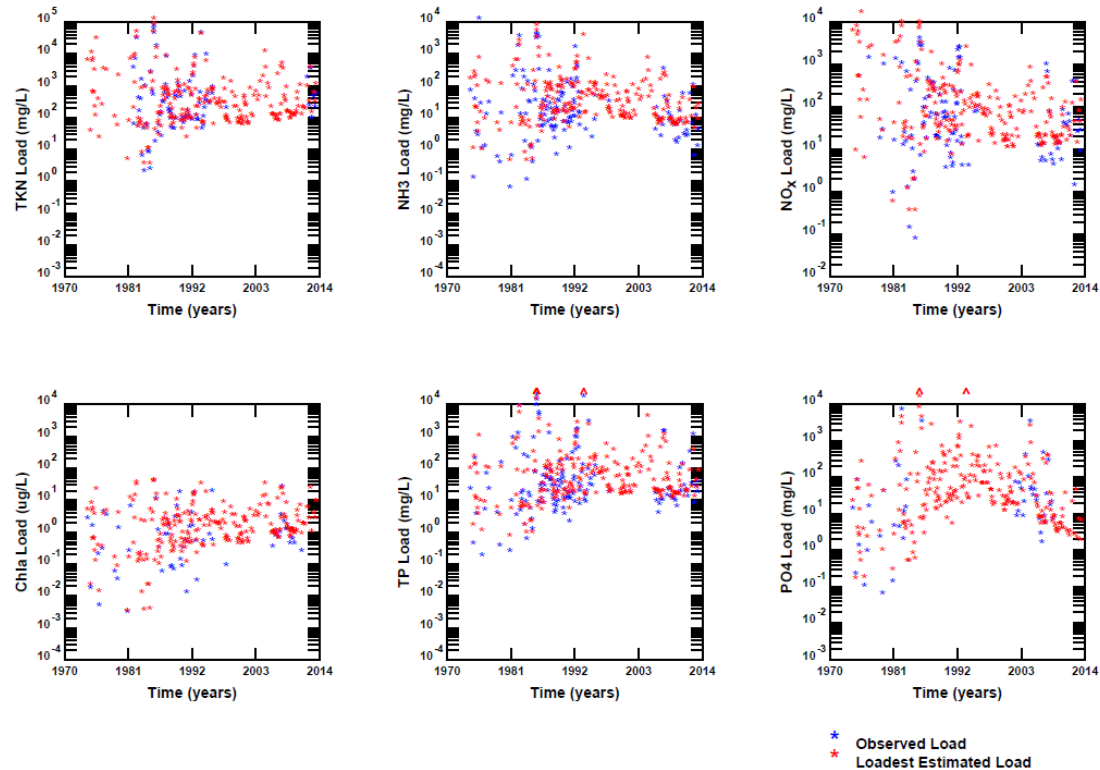
Observed Load vs. Loadest Estimated Load, Station 13005

Nueces Tributaries, Texas (1970-2014)



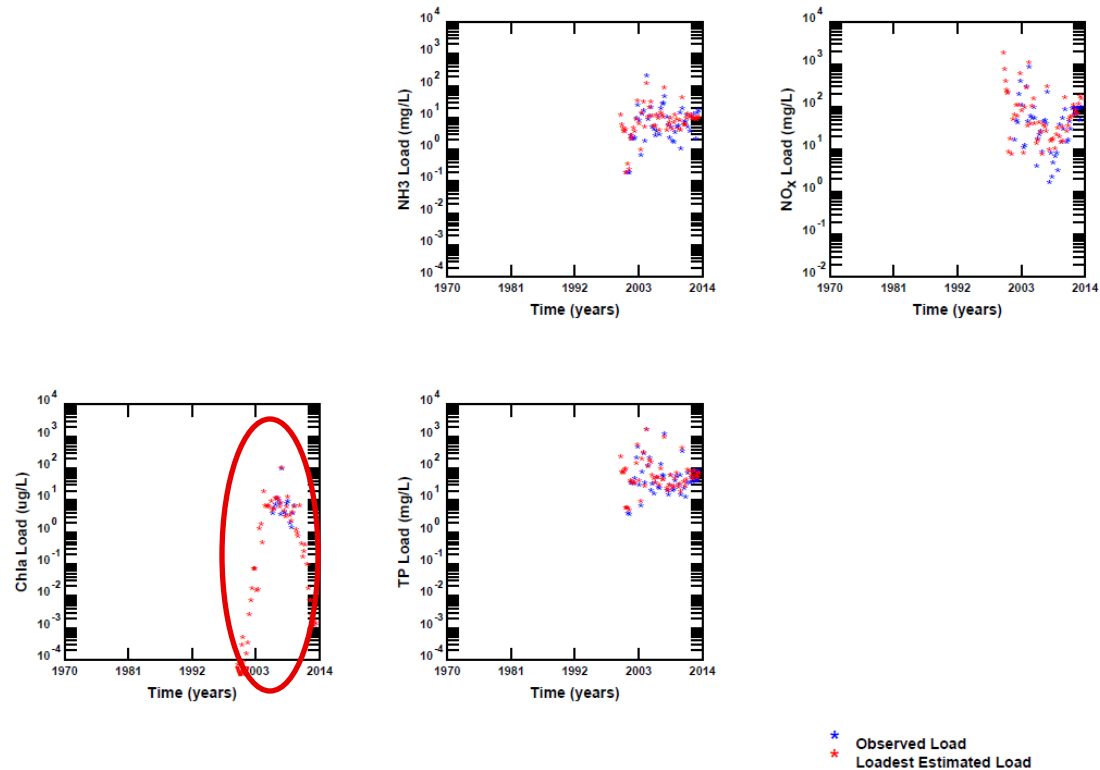
Observed Load vs. Loadest Estimated Load, Station 12973

Nueces Tributaries, Texas (1970-2014)



Observed Load vs. Loadest Estimated Load, Station 12979

Nueces Tributaries, Texas (1970-2014)

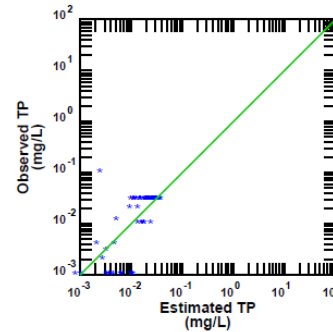
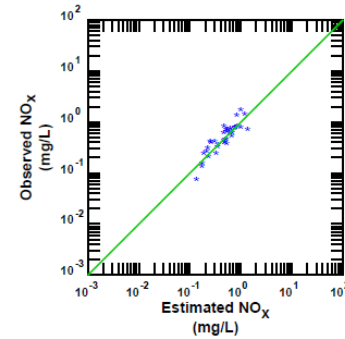
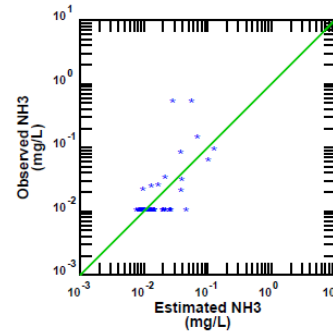


Observed Load vs. Loadest Estimated Load, Station 12964

Nueces Tributaries, Texas (1970-2014)

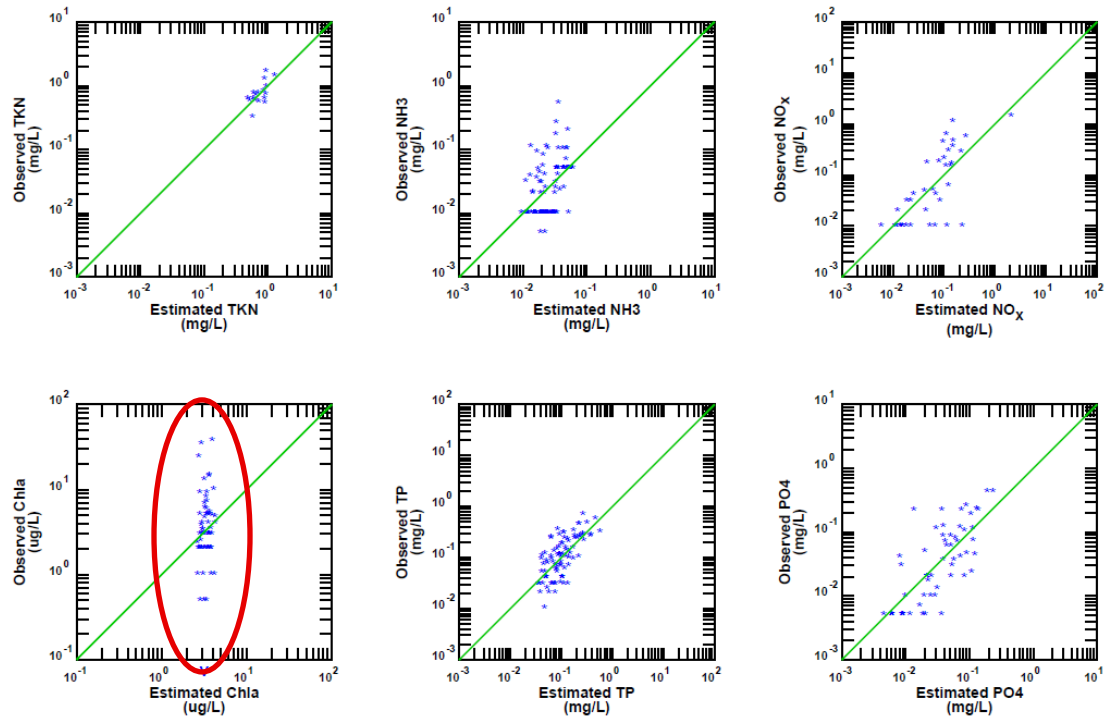
LOADEST RESULTS

Observed vs. Estimated Concentration



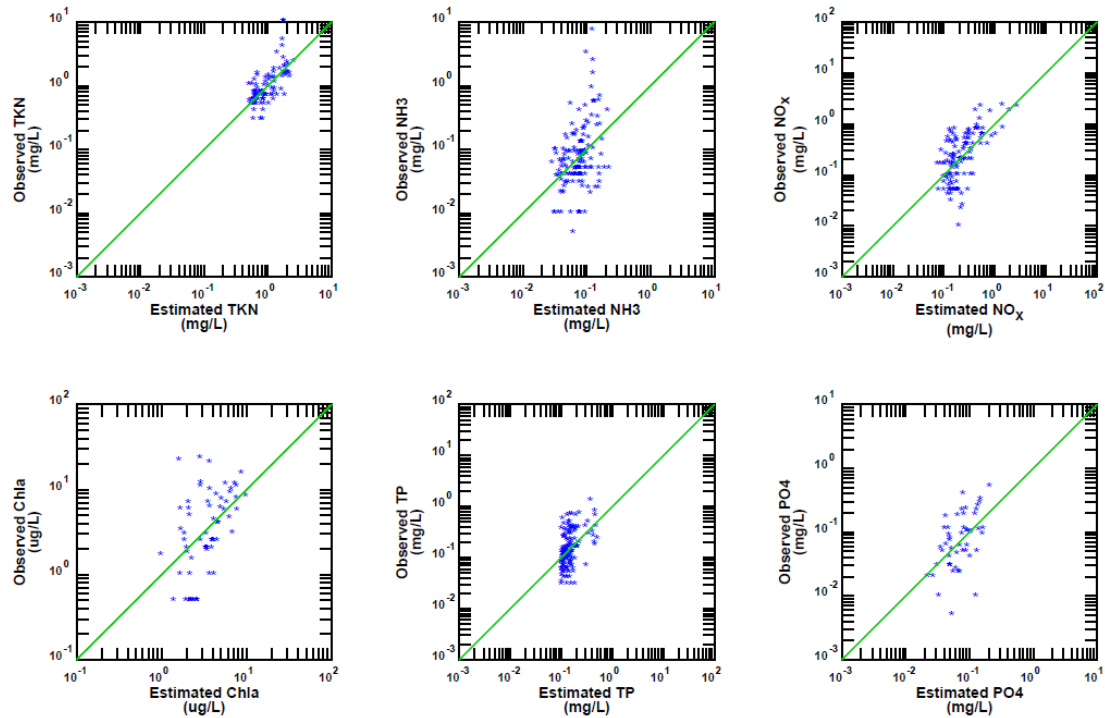
Observed Data vs. Loadest Estimated Concentration, Station 13005

Nueces Tributaries, Texas (1970-2014)



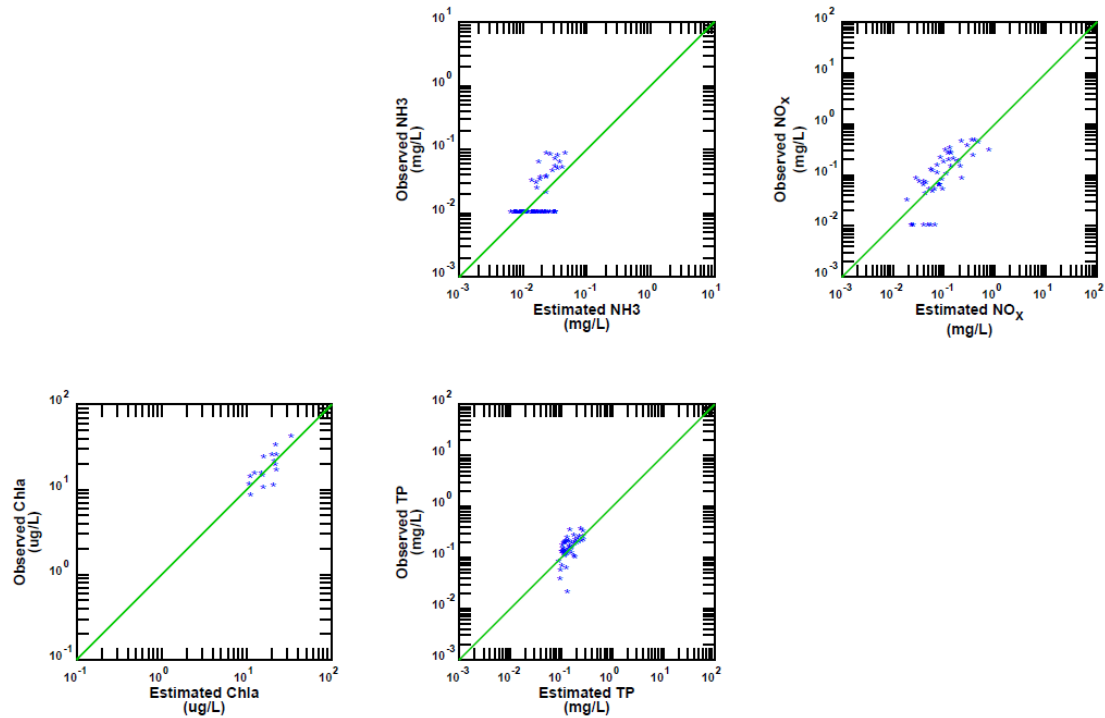
Observed Data vs. Loadest Estimated Concentration, Station 12973

Nueces Tributaries, Texas (1970-2014)



Observed Data vs. Loadest Estimated Concentration, Station 12979

Nueces Tributaries, Texas (1970-2014)

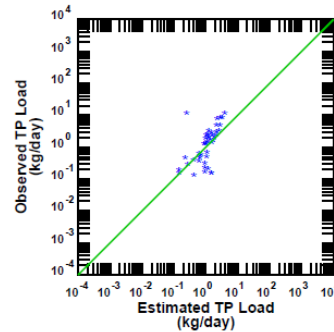
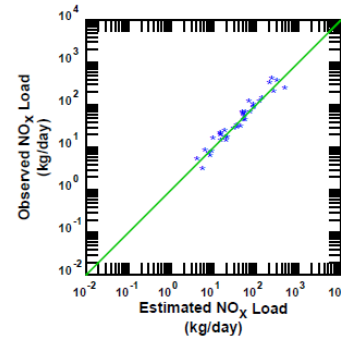
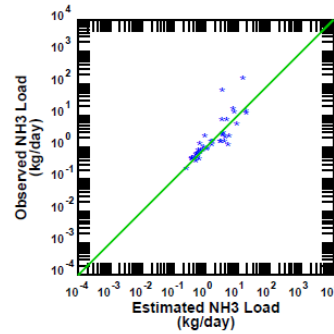


Observed Data vs. Loadest Estimated Concentration, Station 12964

Nueces Tributaries, Texas (1970-2014)

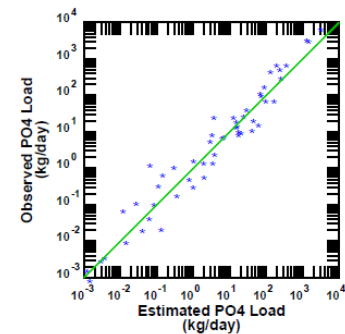
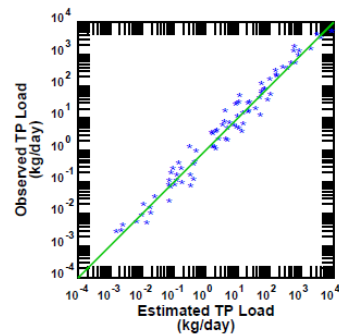
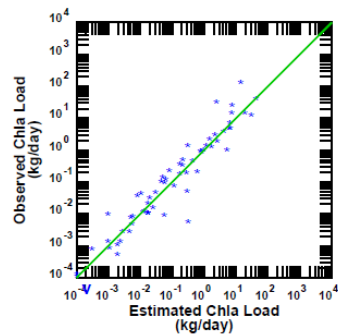
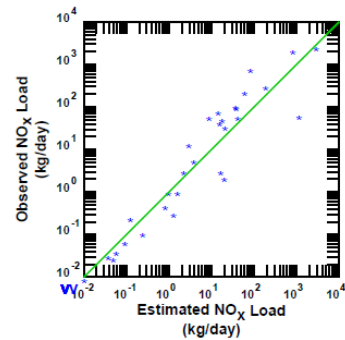
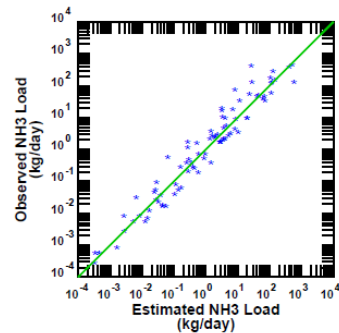
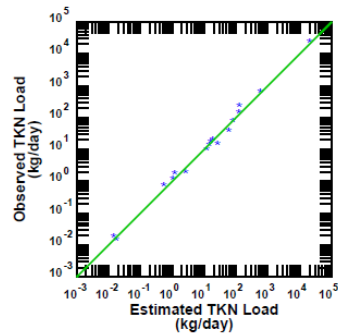
LOADEST RESULTS

Observed vs. Estimated Load



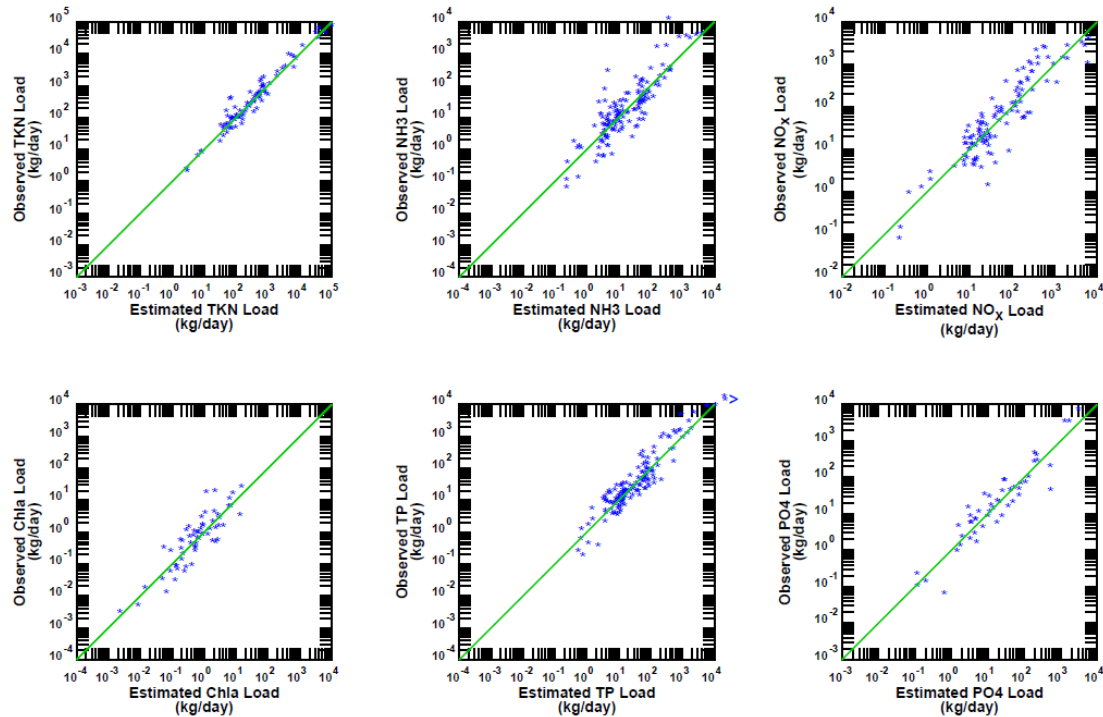
Observed Load vs. Loadest Estimated Load, Station 13005

Nueces Tributaries, Texas (1970-2014)



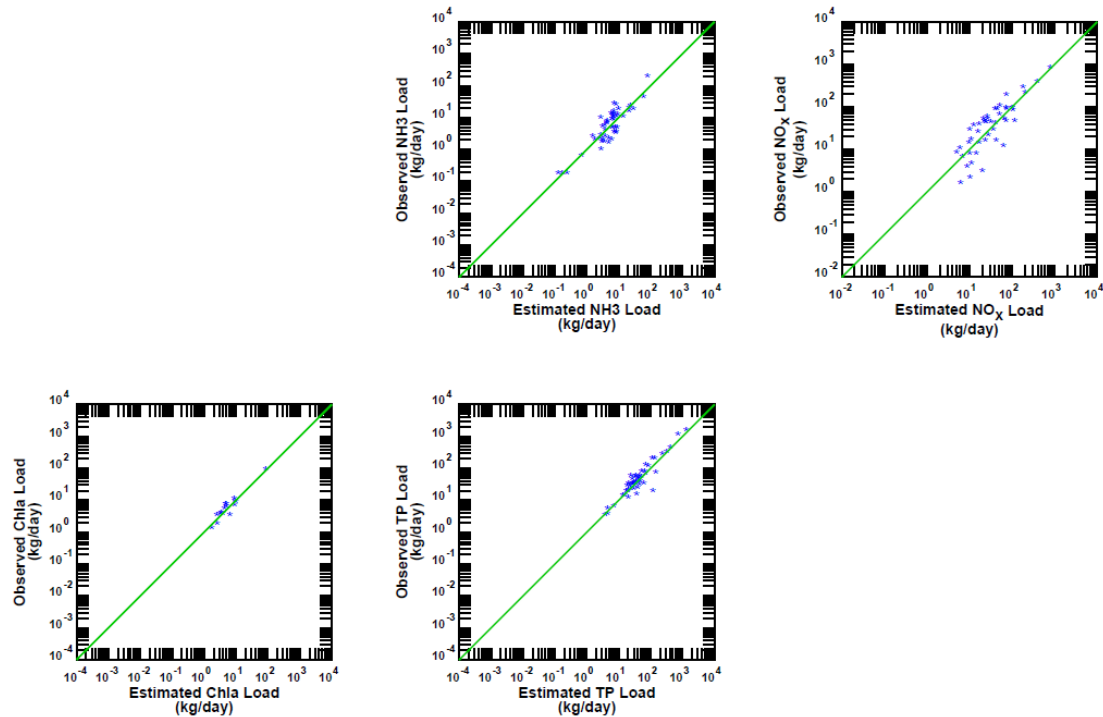
Observed Load vs. Loadest Estimated Load, Station 12973

Nueces Tributaries, Texas (1970-2014)



Observed Load vs. Loadest Estimated Load, Station 12979

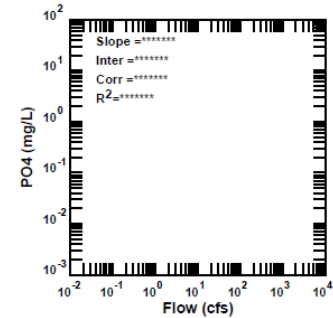
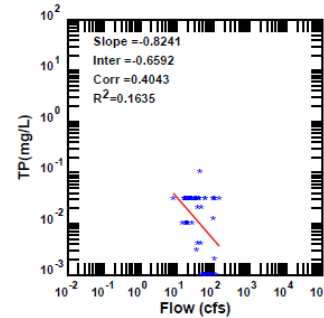
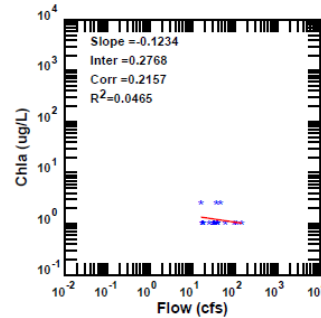
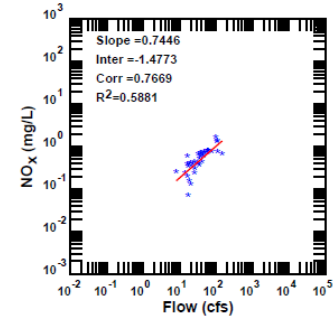
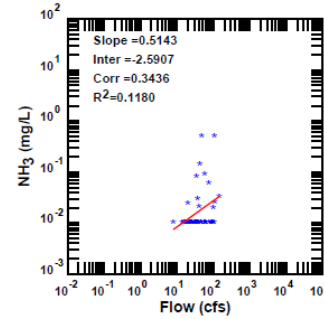
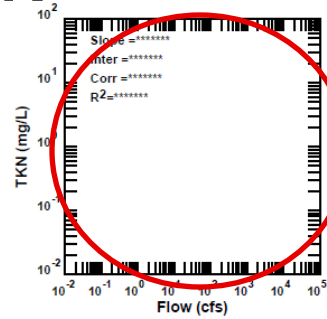
Nueces Tributaries, Texas (1970-2014)



Observed Load vs. Loadest Estimated Load, Station 12964

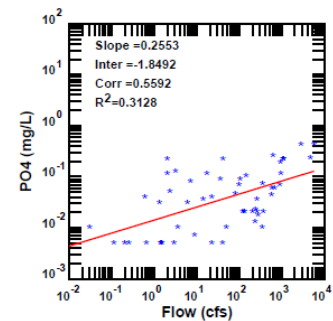
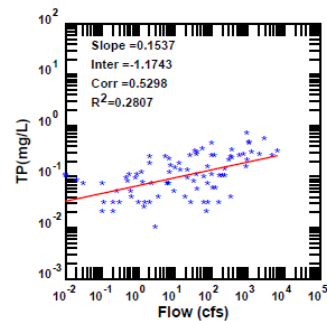
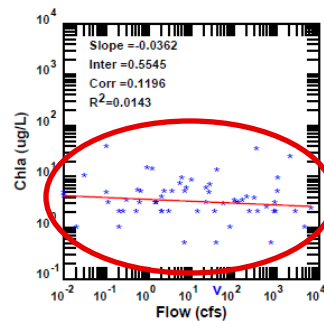
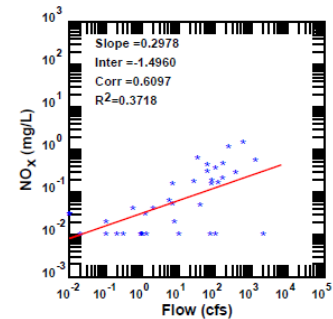
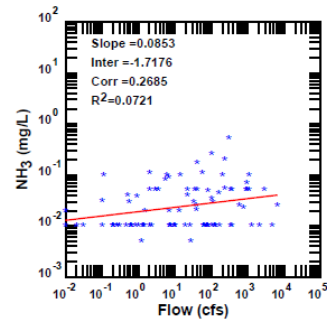
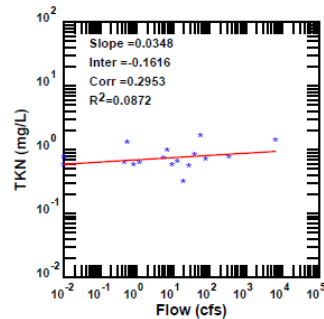
Nueces Tributaries, Texas (1970-2014)

STRAIGHT LINEAR REGRESSION



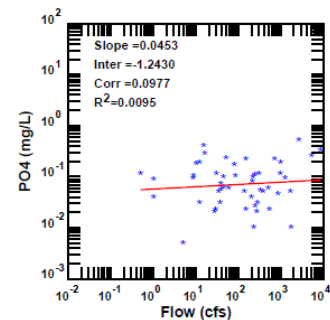
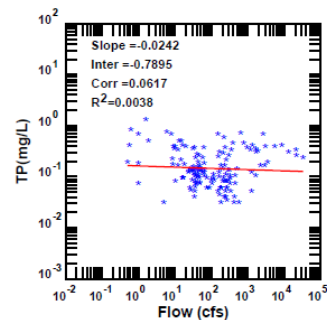
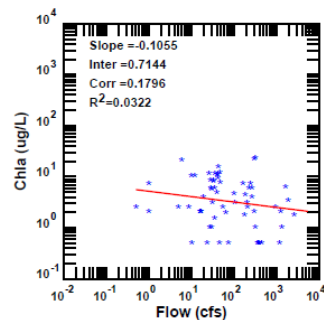
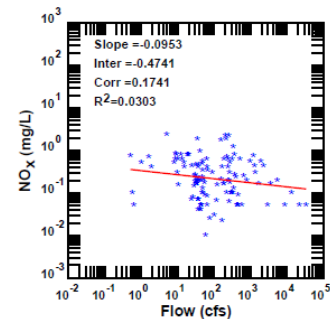
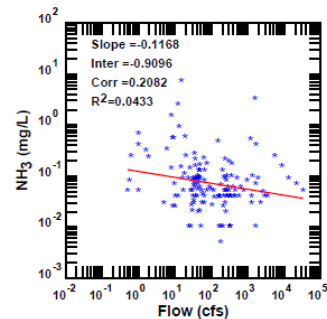
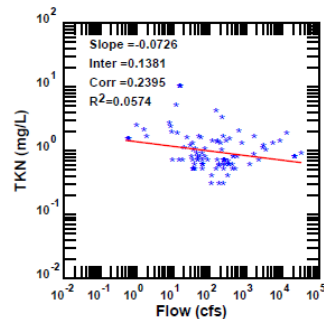
Regression analysis, Station 13005

Nueces Tributaries, Texas (1970-2014)



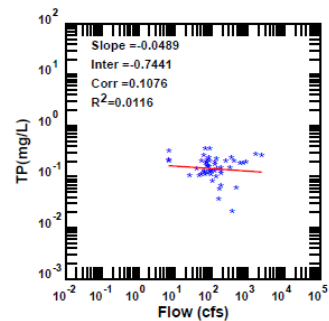
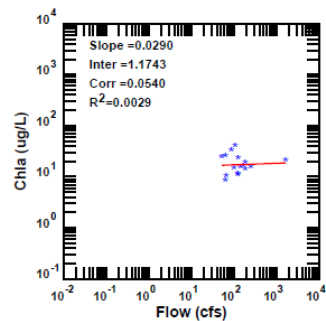
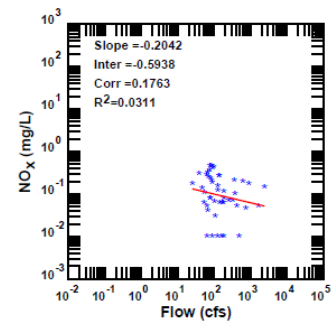
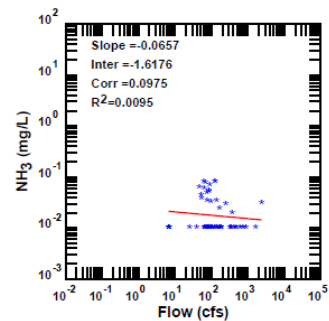
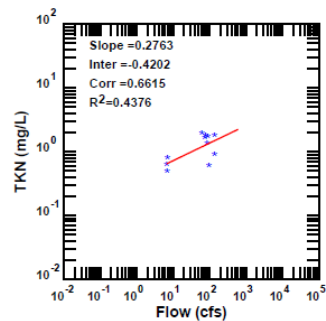
Regression analysis, Station 12973

Nueces Tributaries, Texas (1970-2014)



Regression analysis, Station 12979

Nueces Tributaries, Texas (1970-2014)



Regression analysis, Station 12964

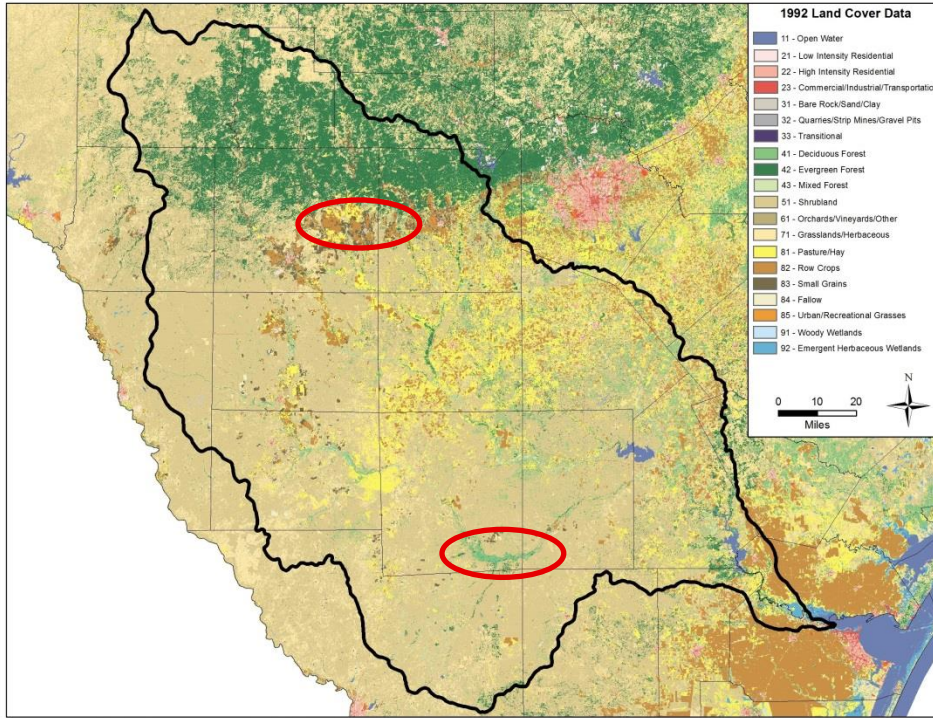
Nueces Tributaries, Texas (1970-2014)

LAND USE ANALYSIS

- Using NLCD to analyze land use changes over time

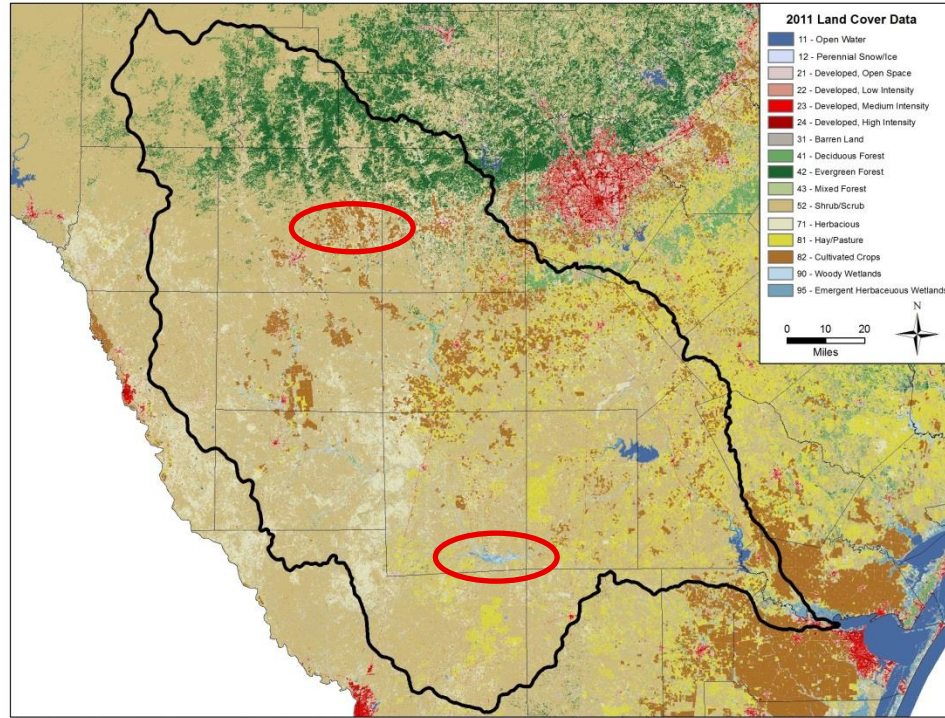


1992



L:\Project_Data\009109_Nueces_BBASC\009109_237741_Nueces_BBASC\GISMap_Docs\Draft\Nueces_Landcover_1992_Original.mxd

2011



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TASK 2 - NEXT STEPS

- *(continued)* Task 2 – Perform Data Evaluation and Modeling Analyses
 - Refine Linear Regression Analyses
 - Estimate Reservoir Influence Sink/Sources
 - Water Quality Correlations to Anthropogenic Changes
 - Pre- and Post-Development Loadings



TASK 3 – MEETINGS AND REPORT

- Task 3 – Meetings and Report
 - NEAC Kickoff Meeting (June 16, 2014)
 - NEAC Meeting Update (October 20, 2014)
 - NEAC Meeting Update (February 23, 2015)
 - Draft and Final Report (2015)
 - Contract Deadline: August 31, 2015



SCHEDULE

- Complete data analysis Nov 2014
- Current nutrient budget Winter 2014-15
- Pre-development nutrient budget
Spring 2015
- Present pre-, post-development results at
Spring 2015 NEAC meeting
- Draft report after analyses
- Final report due August 2015



